THINKOLOGY

INQUIRY

NAME	DATE
John	2/20/80

THINKOLOGY

INQUIRY

Gifted Child Project
ESEA Title IV-C
Leon County Public Schools
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ACKNOWLEDGEMENTS

The following persons were involved with the development, production and evaluation of the *Thinkology* course:

Michael Steve ..... Instructional Designer, coordinator, author
Tedd Arnold ..... Graphic Designer, illustrator

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Illustrations

1. "Bond of Union" by M. C. Escher courtesy of Haags Gemeentemuseum, The Hague.

Activity Packet	Photograph of flood scene courtesy of Wide World Photos, Inc.
Activity Packet	Photograph of accident by Ray Stanyard, Tallahassee Democrat
Teacher Material	Photograph of cloud by Earl Warren, Tallahassee Democrat
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THINKOLOGY

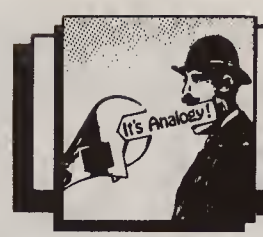
WELCOME TO THINKOLOGY

. . .a study of thinking: using skills to investigate, compare, solve problems and create new things

How To Use It

THINKOLOGY

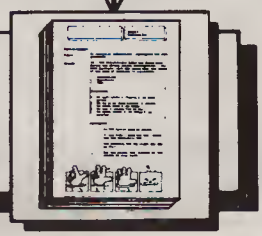
You will be working without much direction from your teacher, so pay careful att
to the directions below and all directions in the lessons.

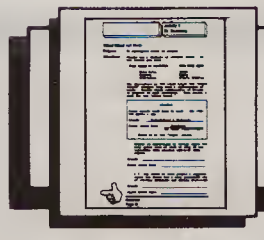


Read from the lesson in this book (sample lesson shown)

Until the hand directs you

Complete an activity from your Activity Packet (the pad)

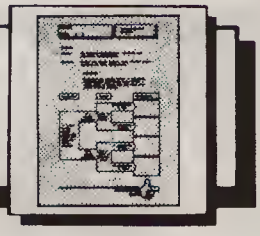




Is it a practice activity (white)

No

Is it a mastery activity (orange)

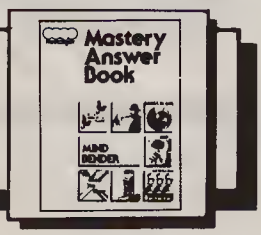


Yes

Yes

Complete it and check your work in "Answers" section at the back of each lesson in this book

Complete it and check your work in the Mastery Answer Book



Did you meet mastery? Check at the bottom of the page.

Yes

No

Then follow the hand back to the lesson or a new activity

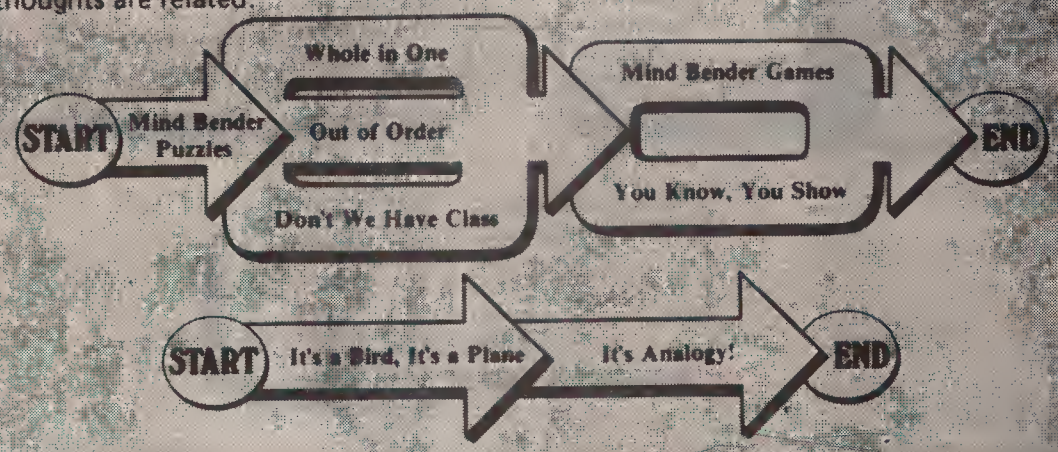
You need to complete a Retake Activity or check with your teacher.

When you complete a lesson, put your activities back in the correct folder. If there are sidetrips (they're blue, at the end of the lesson), do one or two. Then you're ready to begin a new lesson.

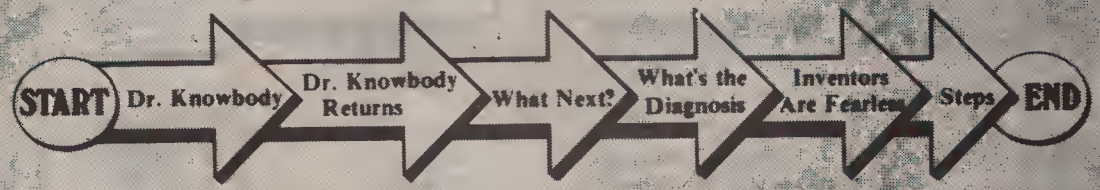
What is Included

THINKOLOGY

MIND BENDER lessons will twist your wits. They're all about how things and thoughts are related.

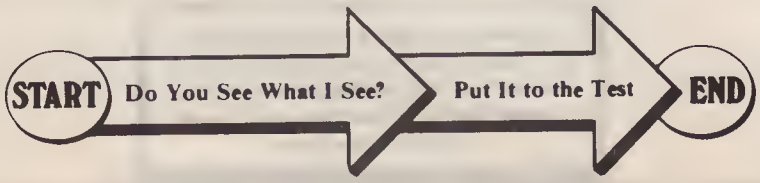


STRATEGIES lessons include tools—not tools for your hands, but thinking tools for your mind. Strategies are ways you can apply your mind to create things and solve what needs solving.



Being a CRITICAL THINKER does not mean finding fault with everything. Critical thinkers think about what they see and hear on TV, read or hear from other people. You'll learn some tools to help you examine and evaluate whether things represent truth or "something less."

INQUIRY is a way of looking at things. It involves trying to understand *why* something happens the way it does. One way to do this is to search for the causes.

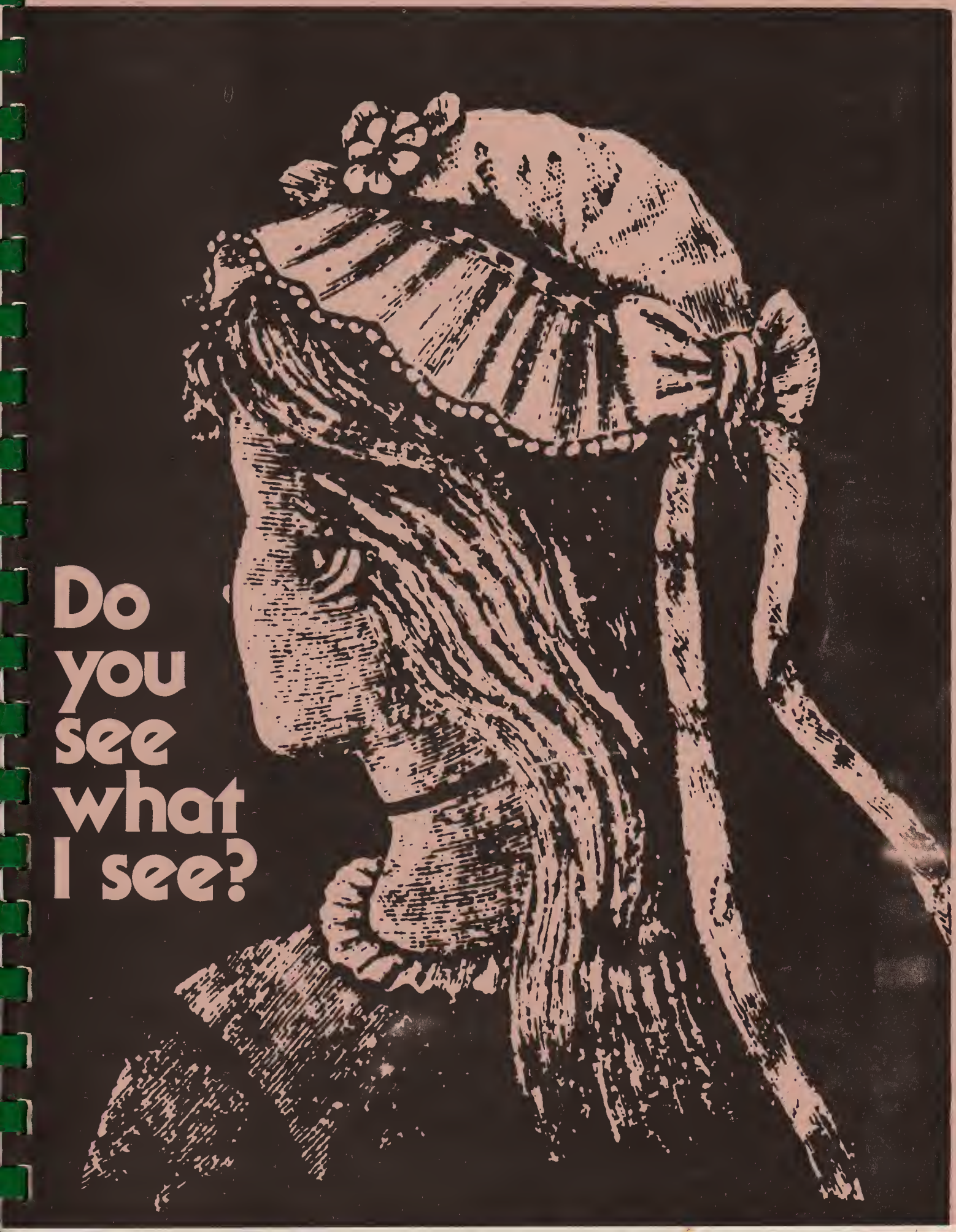


INQUIRY — contents

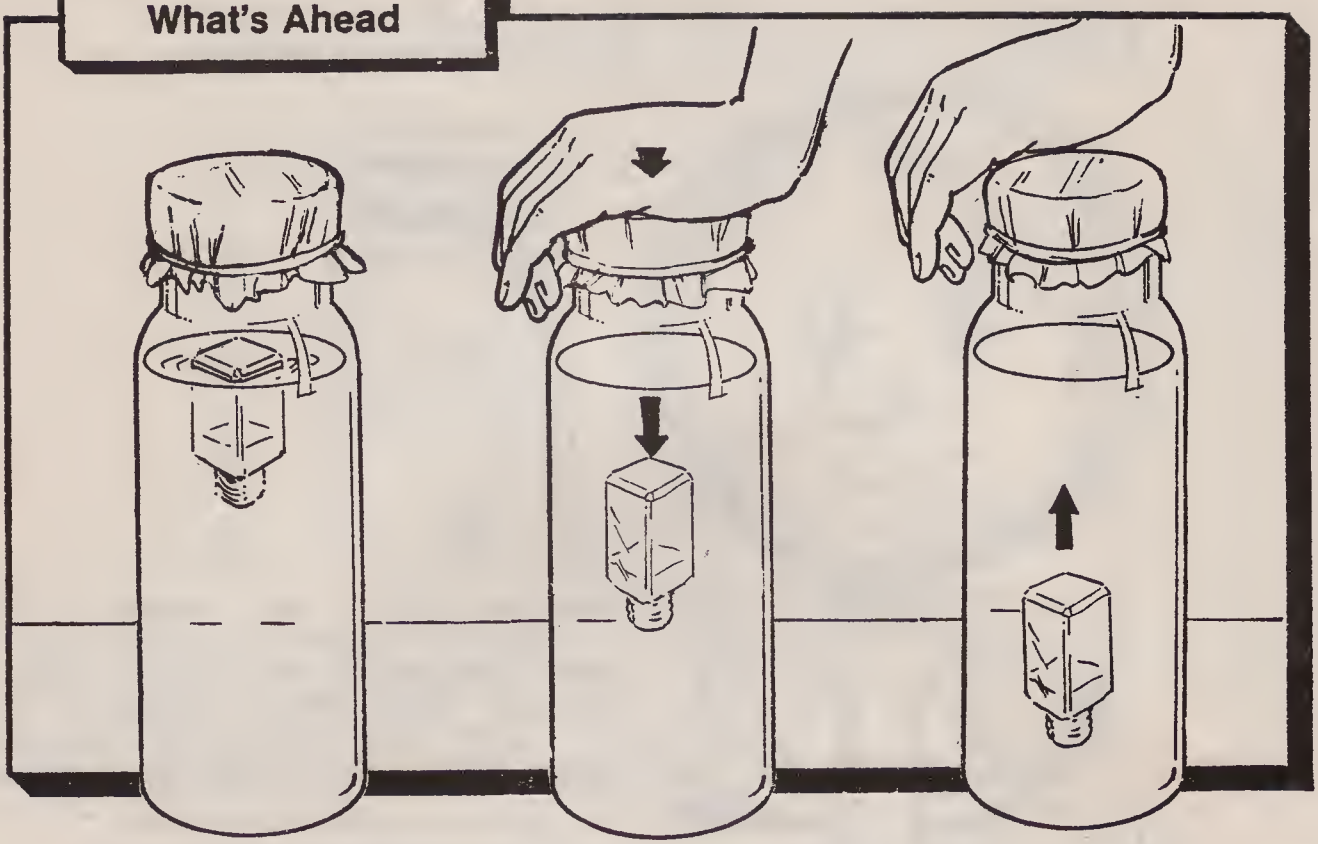
INQUIRY is a way of looking at things. It involves trying to understand *why* something happens the way it does. One way to do this is to search for the causes.

DO YOU SEE WHAT I SEE?
The first step in understanding a puzzling situation is to take a good look—and use your other senses, too. 1

PUT IT TO THE TEST
Inquiry involves asking the right questions, then looking for their answers. You'll have a chance to do both. 17


Do you see what I see?

What's Ahead



What's Needed

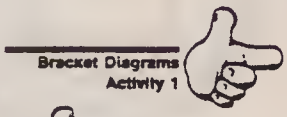
LESSON BOOK: Do You See What I See?

ACTIVITIES: 1-3

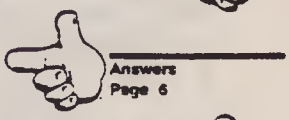
OTHER: None

FOLLOW THE FINGER:

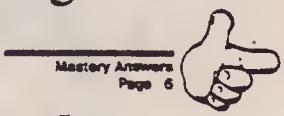
COMPLETE ACTIVITY
from activity packet



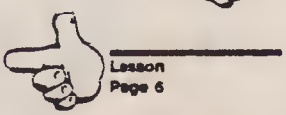
CHECK ANSWERS
in lesson book



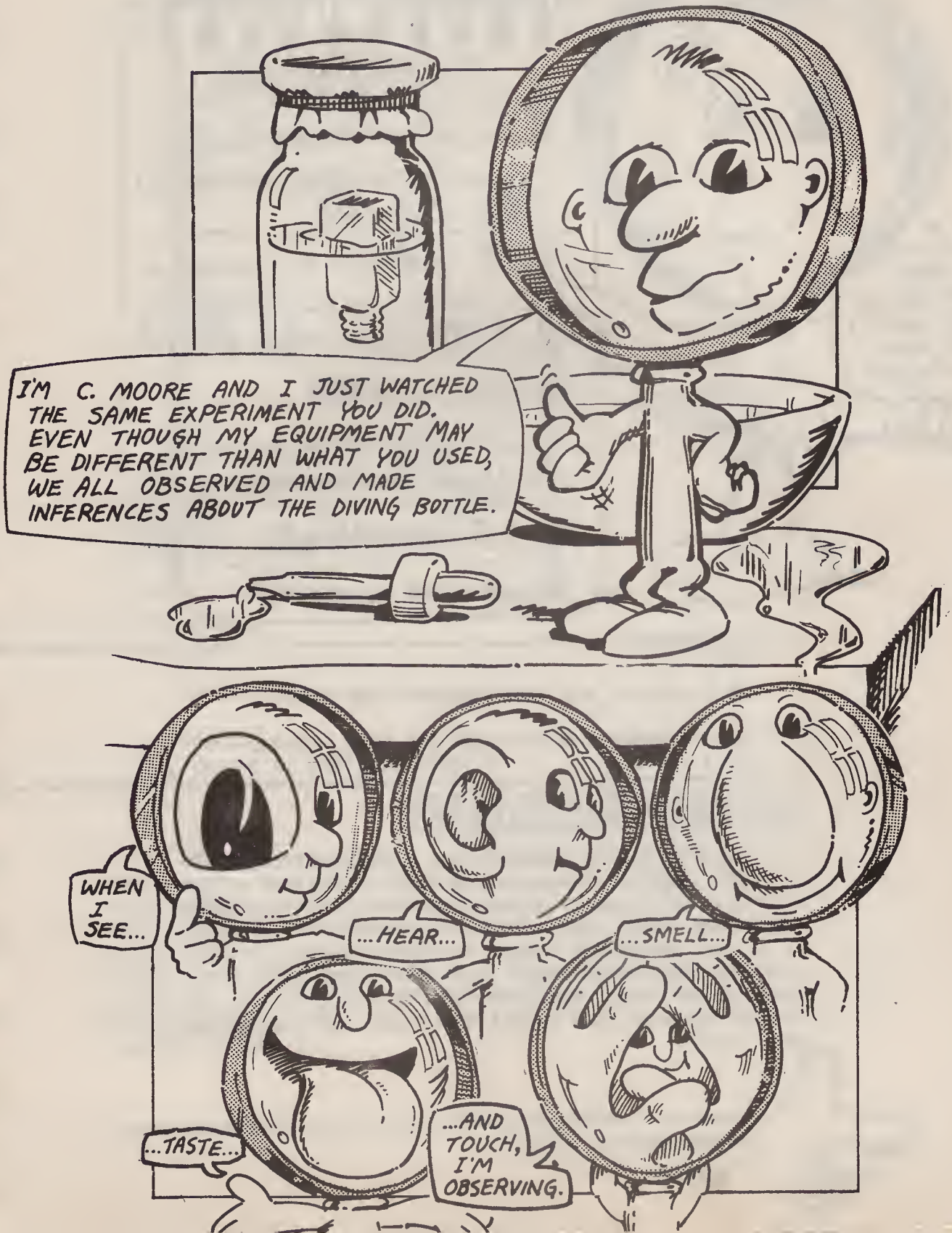
CHECK ANSWERS
in *Mastery Answer Book*

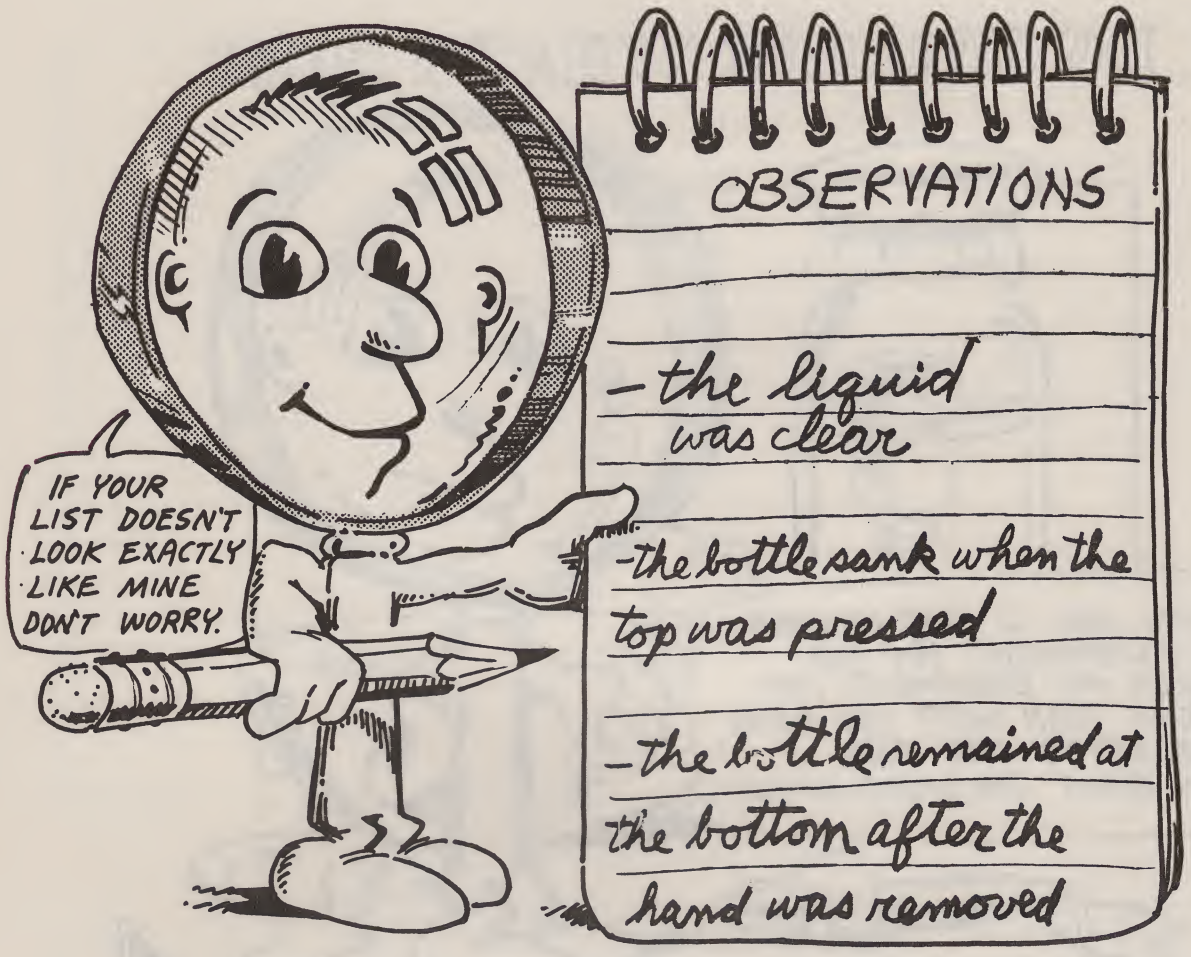


RETURN
to lesson book



DO YOU SEE WHAT I SEE?





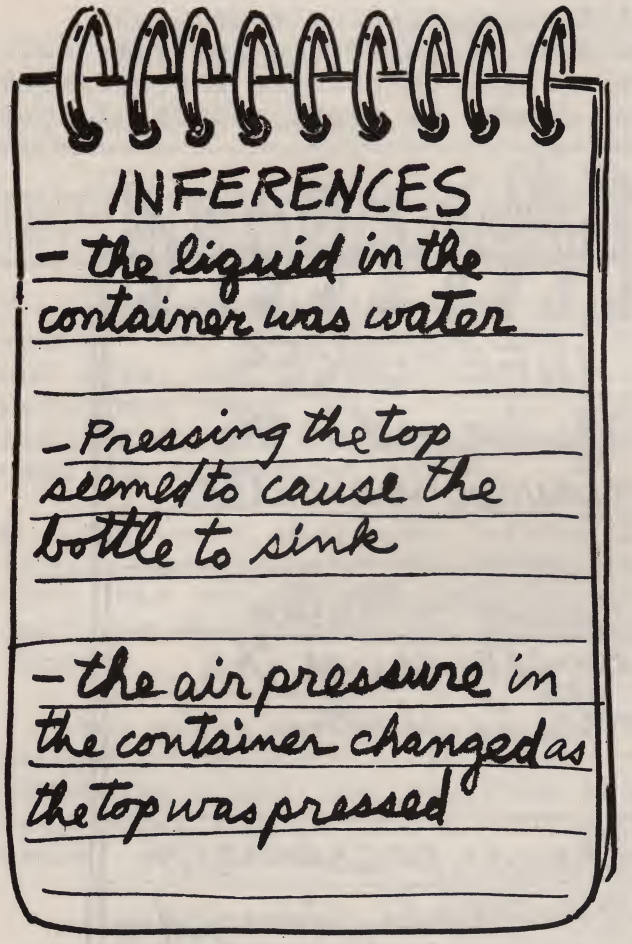
REMEMBER

...Observations are what you perceive (sense)

...Observations are what you see, feel, taste, smell or hear

OBSERVATIONS

What people observe in a situation will be very similar. Look through the list of observations above. Everyone who saw the demonstration would agree with these observations. If a car suddenly stops in the middle of the road, and three people are watching from the curb, each will see the car stop, hear the breaks squeal and smell the burning rubber of the tires.



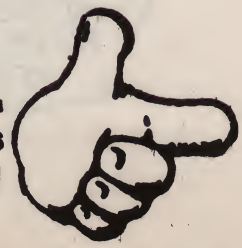
REMEMBER

...Inferences are what you conclude

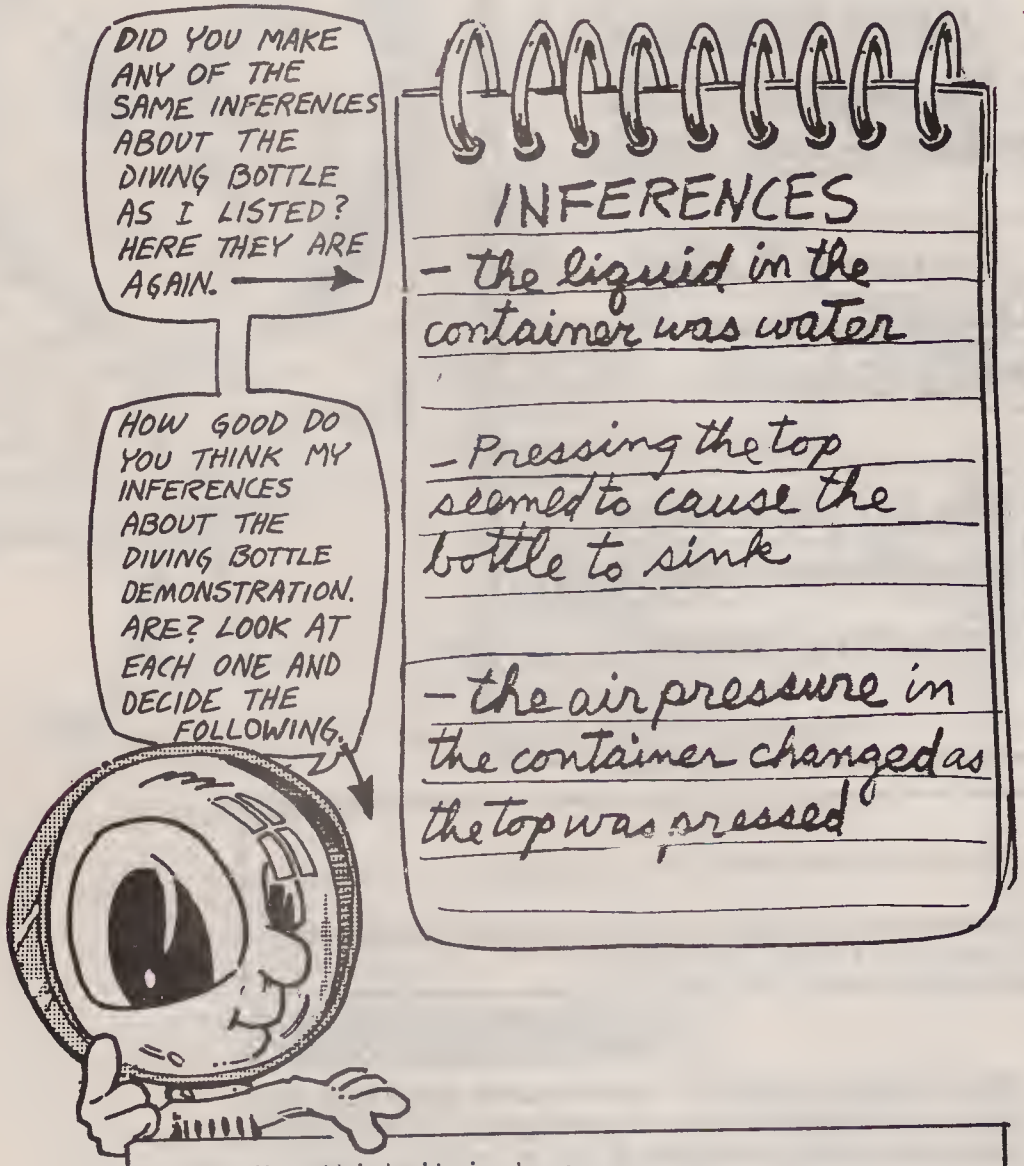
...Inferences are what you think might be true as a result of what you observe

INFERENCES

What people infer (conclude) may not be the same. Consider the three people standing near the car that screamed to a stop. All three would see, hear and smell the same sensations, but each may make quite different inferences. One may conclude that the driver is careless, the other that something must be in the road, and the third that the car is mechanically unsound.



Inferences are not as simple to deal with as observations. Inferences can be true or false. Each person who witnessed the car suddenly stopping made an inference about what happened. All three cannot be right.



T - You think it is true
F - You think it is false
? - You do not have enough information to know if it is true or false

WHEN YOU HAVE AN ANSWER FOR ALL THREE INFERENCES, READ ON.

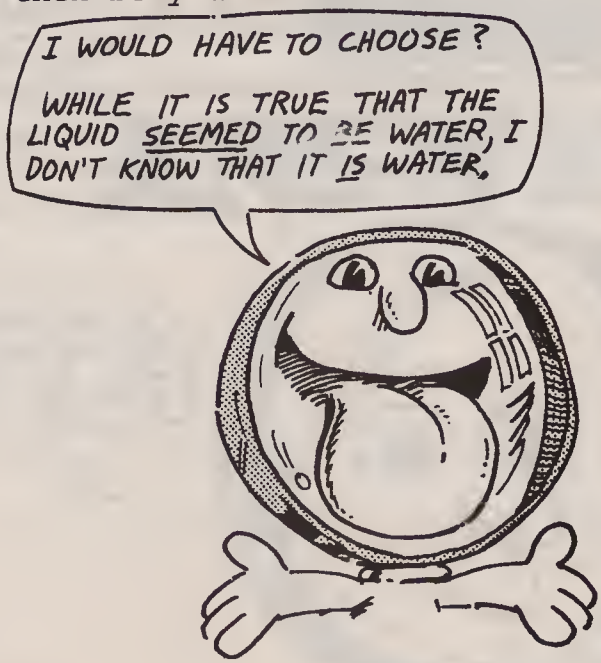
You probably based your choices on your observations and your past experiences with floating and sinking objects. Let's go through each inference.

INFERENCE 1. the liquid in the container was water

T - You may think that the liquid is probably water. You observed that the liquid is clear and thin, and you know from experience that water has these characteristics and that many liquids do not. And you know that water is used for many experiments.

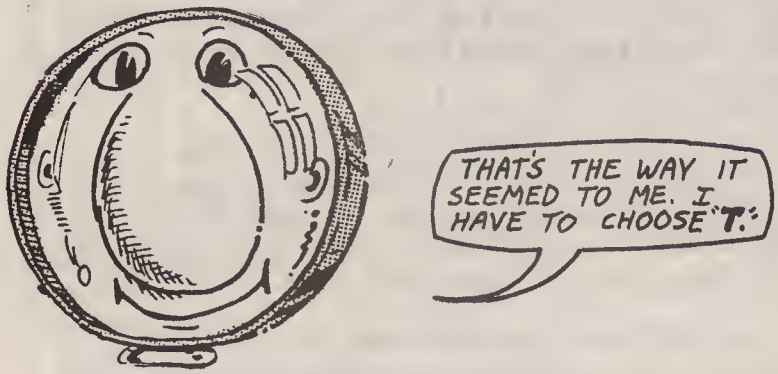
F - You would need some information that the liquid was not water to choose this one. Do you? Did you observe anything, or do you know anything which makes you believe it is not water?

? - You might decide that you do not know enough to say that it is water. Could it be something else? You may know that there are many other liquids which look and act like water. This would then be your choice.



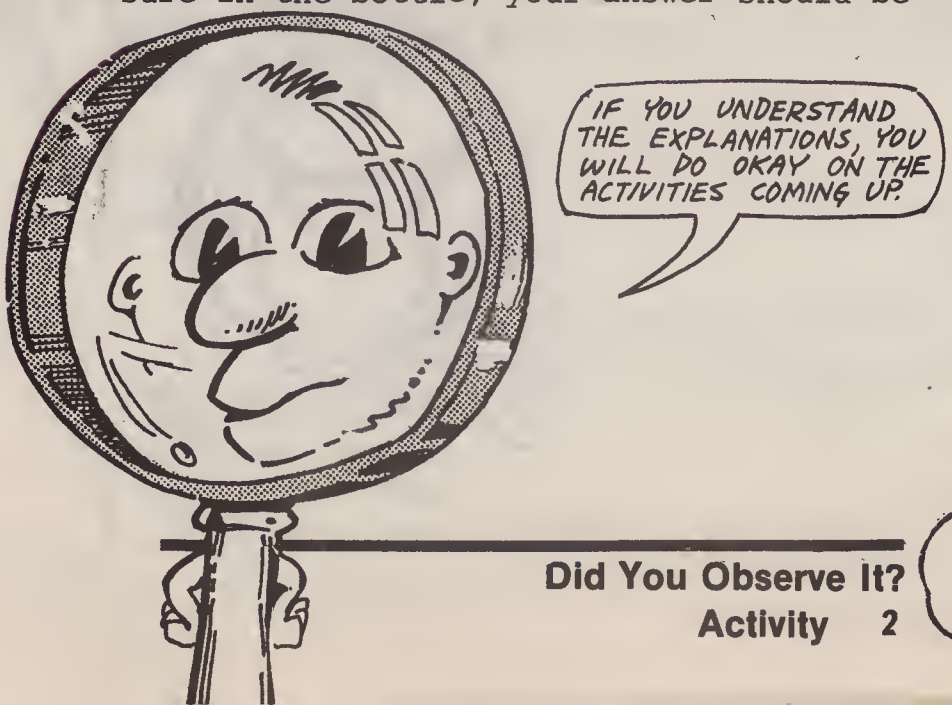
INFERENCE 2. Pressing the top seemed to cause the bottle to sink.

Notice the wording in this inference. Including the phrase "seemed to cause" rather than "did cause" made this statement not as strong. Did it seem to you that pressing the top was the only factor which could have affected the bottle?



INFERENCE 3. The air pressure in the container changed as the top was pressed.

Did you observe any pressure change? If you aren't sure what happened to the air pressure in the bottle, your answer should be "?."



ANSWERS

answers

Activity 1
Do You See What I See?

Facts and Inferences

b 1. Facts:

Many Irish people helped build the Union Pacific Railroad.

Albert Einstein, born outside of our country, came to the U.S. and worked here for the rest of his life.

Inferences:

(a) We can learn much from people who come to our land.

(b) Immigrants have made many contributions.

(c) Albert Einstein taught science.

a 2. Facts:

The effects of dumping wastes will eventually upset the delicate balance of ocean life.

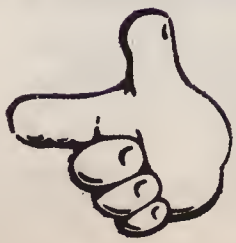
If the population of one species declines, this can affect other species that depend on it for food.

Inferences:

(a) The effects of dumping wastes will affect many species.

(b) The dumping of wastes should stop immediately.

(c) Some species of fish may become extinct.



answers

Activity 3
Do You See What I See?

Can You Make That Inference?

(A)
- ___?___ 1. Ben and Abel have fought before.
- ___F___ 2. Abel does not own a watch.
- ___?___ 3. Abel recognized Ben.
- ___T___ 4. Abel was concerned that his watch was missing.

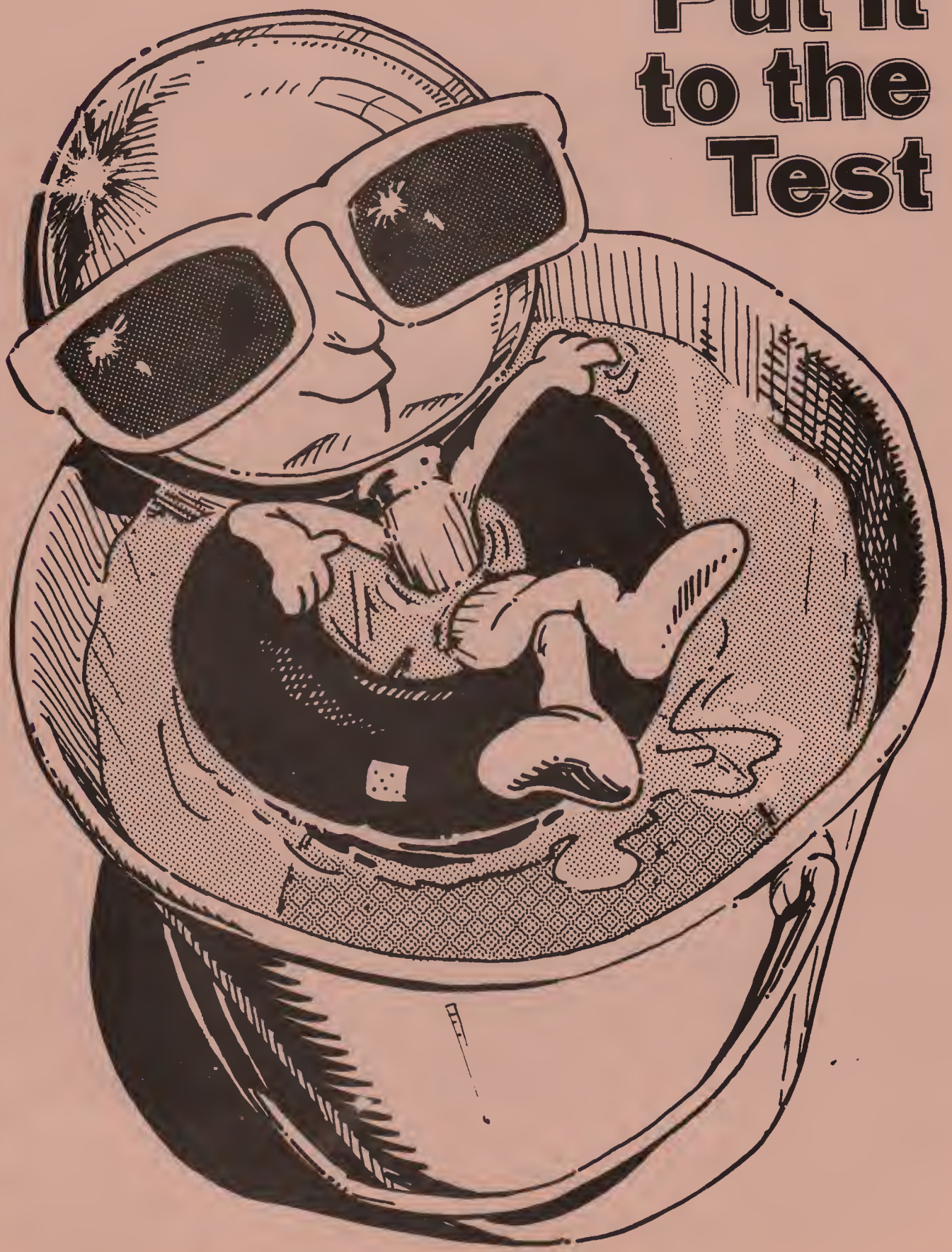
(B)

	OBSERVATION	INFERENCE
___?___	A penny was tossed 10 times and 8 times "heads" came up and 2 times "tails" came up.	The next time it's tossed it will come up tails.
___?___	Some of the lights in New York City aren't working.	There is a power failure which is affecting New York City.
___F___	Cary scored much lower on the test than Betty.	Cary was probably as well prepared for the test as Betty.
___?___	A bird is flying from tree to tree.	The bird is part of a flock.
___T___	Luther has a bag of 40 marbles, 30 of which are white, the other 10 red.	If Luther chooses a marble from his bag without looking, he will probably choose a white one.

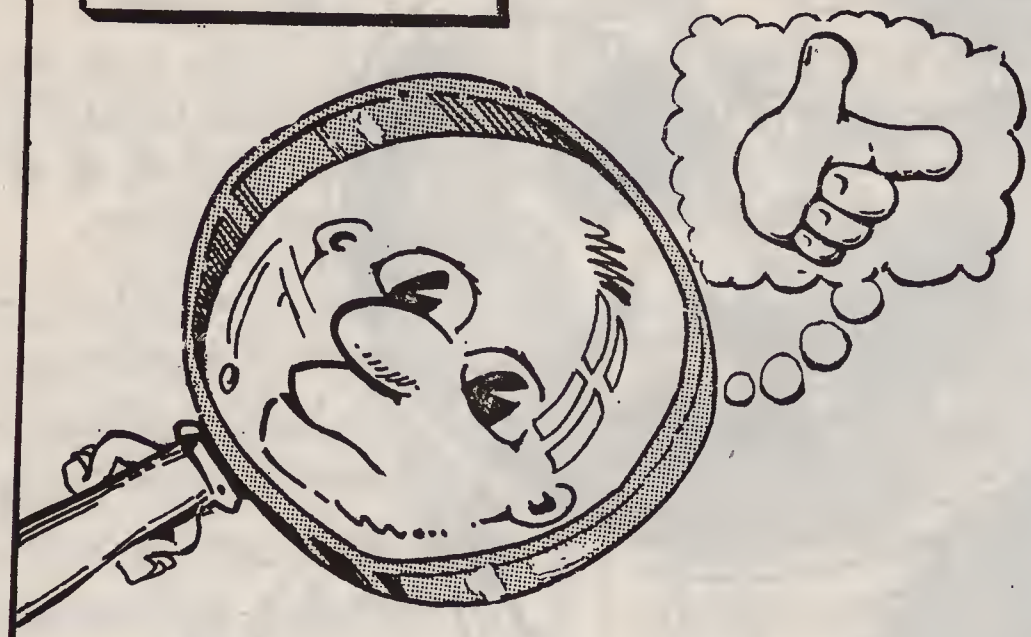
Congratulations

You have completed the last activity in *Do You See What I See?* You are ready for a group inquiry session.

Put It to the Test



What's Ahead



What's Needed

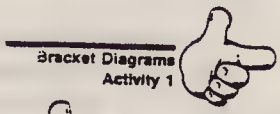
LESSON BOOK: **Put It to The Test**

ACTIVITIES: **1-3**

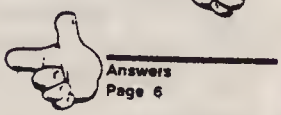
OTHER: **None**

FOLLOW THE FINGER:

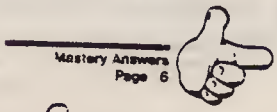
COMPLETE ACTIVITY
from activity packet



CHECK ANSWERS
in lesson book



CHECK ANSWERS
in *Mastery Answer Book*



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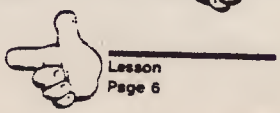
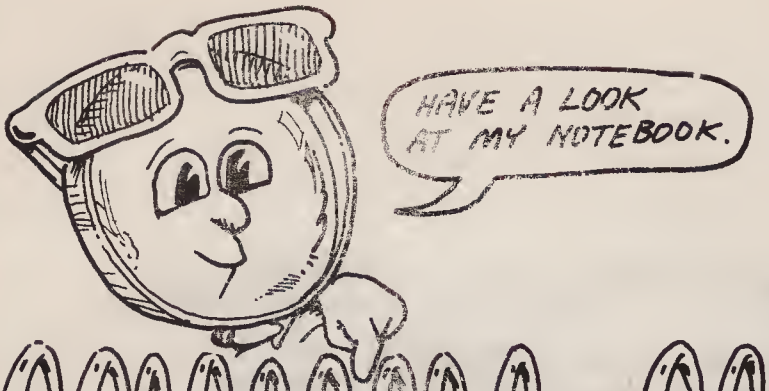


Hello again, C. Moore here...the looking glass that's looking good.

I'm restin' now. I have been observing the same water funneling demonstration as you did. I used a can with a hole in the bottom of it--you may have used different equipment. But we made many of the same observations, including seeing the clockwise spin.



OBSERVATIONS	INFERENCES
- water is stirred counter clockwise	- the water would not flow clockwise in a bathtub
- salt is added each time: first time, 3 shakes; second time, one shake	- the shape of the hole caused the clockwise movement
- parsley flakes are added	
- water spins in a clockwise direction as it flows out	

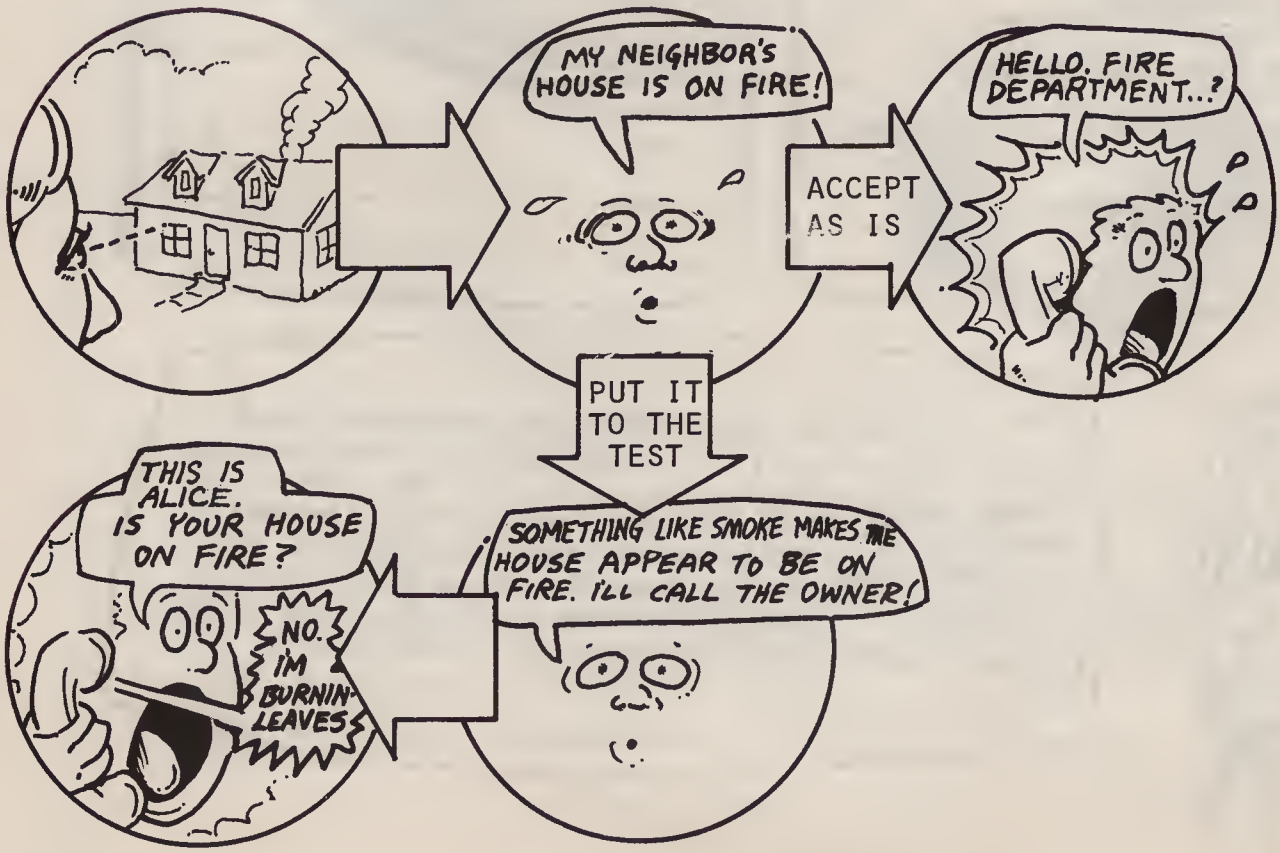
If you saw the same demonstration, your observations will be very similar. But as you know, inferences, like opinions, can vary from person to person. Probably the most interesting inferences are those which attempt to explain <u>why</u> the water spun out in a clockwise direction. These inferences are the ones which become hypotheses and are PUT TO THE TEST.

Putting It to the Test

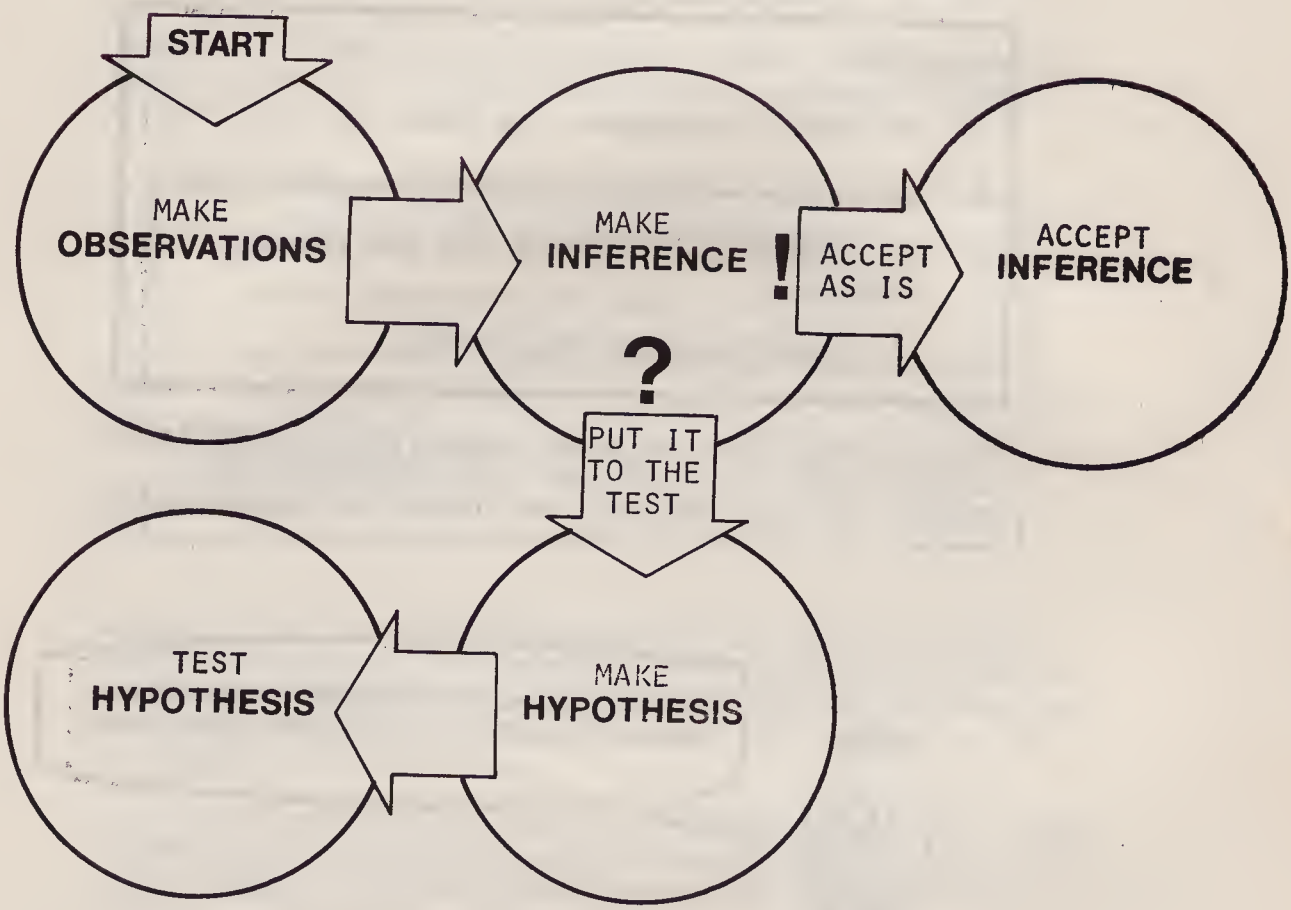
When you put an idea (or an inference) "to the test," your purpose is to gather more information about your inference. For example, if you saw smoke coming from behind a house across the street, you might infer that your neighbor's back porch was ablaze. But would you want to accept this as fact and call out the fire department, or first test it out?

Testing it out would be fast and simple. When you decide to test your inference, the inference is then called a "hypothesis." A hypothesis (high-POTH-e-sis) is a guess--a guess you intend to test.

How could you test your hypothesis about the fire?...by phoning your neighbors...by running across the street to see what's going on.



Here's a diagram showing the path your investigation would take.



Two steps in the diagram, MAKE HYPOTHESIS and TEST HYPOTHESIS, may be new to you. Read on to discover why these are the most interesting of the inquiry process.

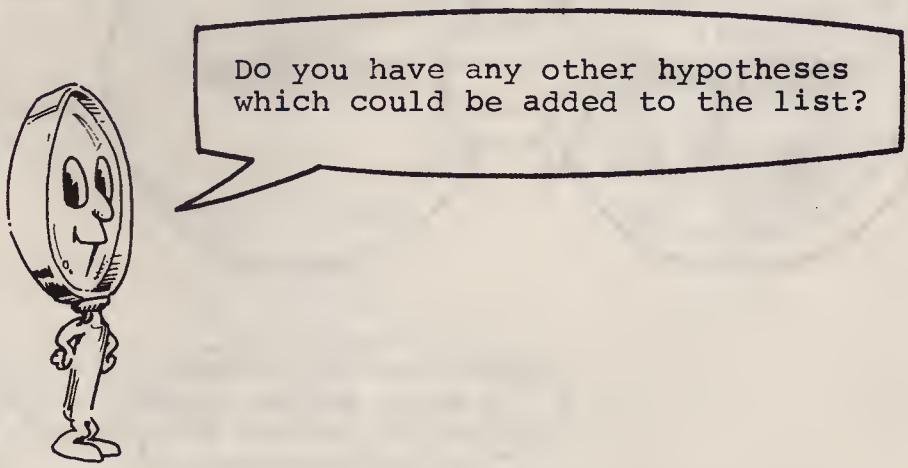
Make Hypothesis

In inquiry, the most interesting question is "why?" To find out why something happens, you focus on finding its cause. For example, if you observe what looks like smoke coming from behind a neighbor's house, there could be many potential explanations (hypotheses) for what is happening.

HYPOTHESES:

1. The back of the house is on fire.
2. The smoke is caused by a rubbish or grass fire.
3. The neighbors are having a big (and smokey) barbecue.
4. It's something other than smoke.

It's a good idea to make your list as complete as you can. In this way, you minimize the chance of missing the real cause or explanation.



Test Hypothesis

Why test a hypothesis? When you test a hypothesis, you are looking for additional information. You want to find if any one of your hypotheses (potentional explanations) is the true explanation.

For example...

> After spying smoke, Alice wanted to find out if the house was on fire. She needed to test one of her hypotheses, #1.

How do you test a hypothesis? There are different ways to do it. Which you choose depends on your hypothesis and what you can do.

GENERAL WAYS OF TESTING HYPOTHESES

1. Look up information in books, reports, etc.
2. Question others--persons involved, other observers, experts, etc.
3. Make new observations, with or without setting up an experiment.

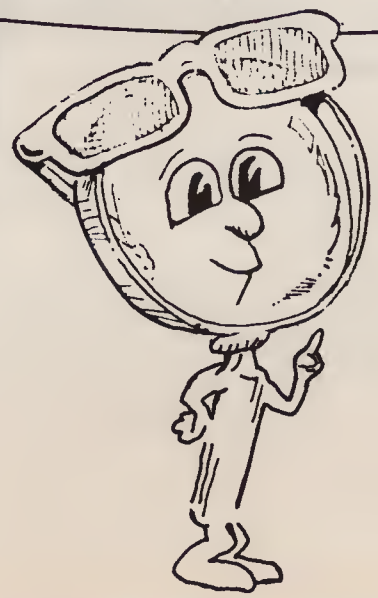
Alice could have used either of two ways to test her hypotheses. She could have "questioned others" or "made new observations." Instead of looking for herself, she called her neighbor and asked him if his house was on fire.

You may find through testing, however, none of your hypotheses adequately explains what you observe. This happens because there are many questions for which no one has answers.

Let me show you how I went about testing a hypothesis from my observations of the funnel experiment. First I made some hypotheses. Here are the three I listed:

1. The Earth's rotation (its spinning) causes the water to spin that way.
2. Unobservable water elves swim in clockwise circles.
3. Stirring the water counterclockwise created a clockwise current in the water near the bottom.

Then I went about testing my hypotheses. I looked over the list to choose one to test first. Hypothesis #3 is the only one I could test in my laboratory. After selecting the hypothesis to test, I had to consider how I would actually go about testing it. Since the purpose is to find out additional information, I decided to do additional experiments. In a series of experiments, I stirred the water counterclockwise, then clockwise, and then I didn't stir it at all. Each time the water flowed clockwise as it flowed down the drain. I don't think Hypothesis #3 is the explanation.



What about the other two? Some people would say Hypothesis #2 is not a good hypothesis because there is no way to test it. They might ask, "How can you observe something which is unobservable?"

Many people offer hypotheses which cannot be tested. Here are a few examples.

It was magic.

It was spirits, (ghosts, or witches, elves, gods, devils, leprechauns, dwarfs, etc.).

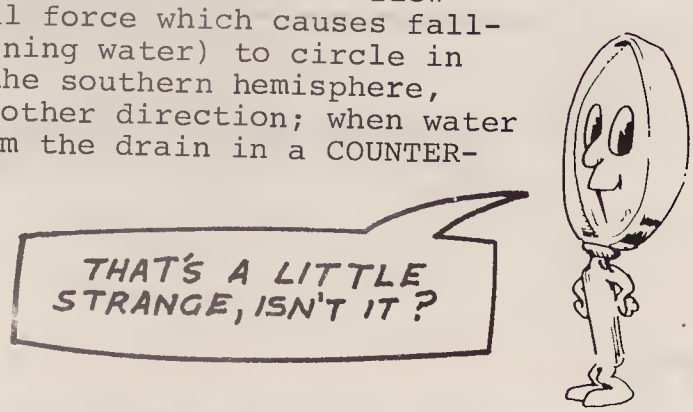
It was bad or good luck.

These hypotheses could explain all sorts of happenings: why it rains on the day of your outdoor party, why some people seem to get all the "breaks" and why some don't. Unfortunately, no one can test such all-purpose explanations. In the end, you either accept or don't accept these untestable hypotheses based on something less than fact.

How could you test Hypothesis #1? One way would be to make new observations by stopping the world from spinning and seeing if the clockwise flow continued. Of course, this can't be done.

You could look up the information in a science resource. Or you could question others. Scientists could help you. If they conducted this experiment on the moon (which does not rotate) can you guess what they would find? The funnel would not appear. Why? The Earth's rotation CAUSES the clockwise funnel--that's the true explanation.

In the northern hemisphere (the part of the Earth above the equator), the clockwise flow results from a natural force which causes falling liquids (the draining water) to circle in that direction. In the southern hemisphere, this force is in the other direction; when water empties, it flows from the drain in a COUNTER-CLOCKWISE funnel.



Inquiry Questions

One of the best ways to find an answer to the question "why?" is through asking questions. To help you in future inquiry explanations, three kinds of questions will be particularly useful. Note the differences in the kinds of information each question is requesting and study the examples.

	INFORMATION REQUESTED	EXAMPLES
Information Questions:	To find out the FACTS of the situation and to test out your INFERENCES	Is the liquid water? Is that regular salt you added?
Hypothesis Questions:	To ask about a HY-POTHESIS (potential explanation/cause)	Could the stirring have created the clockwise flow? Could the shape of the hole cause the clockwise flow?
Test Question:	To TEST your hypotheses; To help you determine whether you should accept the hypothesis?	If you had not stirred the water, would you still observe the funnel? If the shape of hole were square, would the water still empty in a clockwise flow?

Do you think you can identify a question as being either one of the three kinds? If so...

ANSWERS

answers

Activity 1
Put It to the Test

Put It To It

d 1. (a) A jet plane crosses the United States from east to west in about four hours.

(b) Some 500,000 American Indians live in the United States.

(c) Jacqueline Cochran was the first woman to break the sound barrier.

(d) The Soviets have a global rocket which cannot be destroyed by our anti-rocket devices.

d 2. (a) Regular airmail service between the east and west began in 1924.

(b) A chicken is a type of bird.

(c) Benjamin Franklin was an inventor as well as a diplomat.

(d) Soil erosion is the greatest problem in the Midwest.

c 3. (a) The area of Alaska is less than the area of Brazil.

(b) Lincoln was born in 1809.

(c) Alaska's population will continue to grow more rapidly than that in other states.

b 4. (a) More Cadillacs were produced this year than last.

(b) Democracy is a better form of government than most others.

(c) July 24, 1724 was a Tuesday.

Could It Explain?
Activity 2

answers

Activity 3
Put It to the Test

What's the Question?

(A)
I 1. Is the bottle made of glass?

T 2. If you didn't push the top, would the top eventually fall?

H 3. Did pressing the top cause the top to fall?

H 4. Did the bottle fall because of the warmth of your hand?

(B)
3 1. If the person chose, could he ride to the 22nd floor in the morning?

1 2. Did he walk from the 10th floor to the 22nd floor each morning?

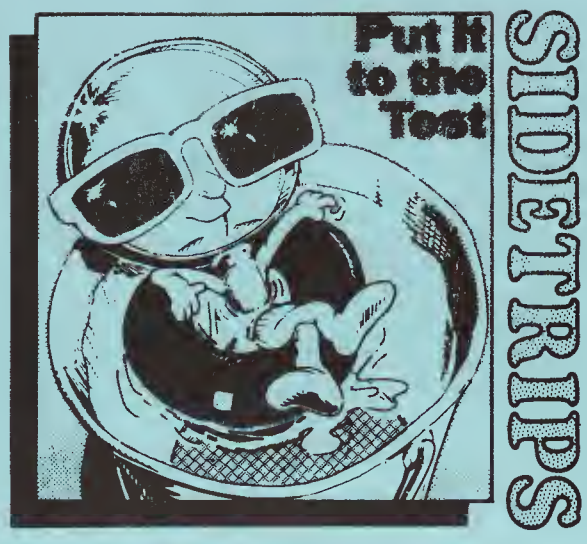
2 3. Did the elevator go no higher than the 10th floor in the mornings?

And if mysterious water elves ever blindfold you and carry you to a far-away land, REMEMBER, you can get some idea of where you've been taken by watching the spin of the water as it empties through a drain.

Congratulations

You have completed the last activity in *Put It To The Test*. You are ready for the sidetrips starting on page 37 and a group inquiry session.

GAME INDEX



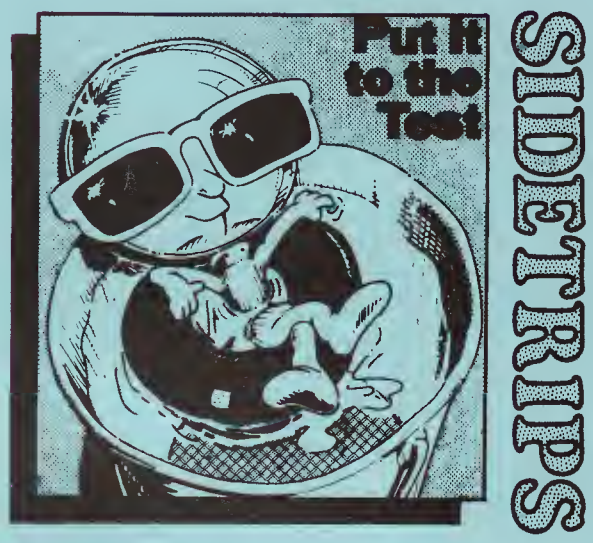
Directions and parts for the game are in labeled bags*

GAME NAME	NO. OF PLAYERS	APPROX. TIME
Convoy	2	20 min.
Letter Shape	2	20 min.
What's the Rule?	2	20 min.
Sunspot	2	15 min.
There's A Leak	2	15 min.
In-Quest*	2-4	60 min. per section

** if available*

Other sidetrips follow this page.

AS DAY FOLLOWS NIGHT



NEEDED:

1 student
Paper & pencil

WHAT'S DOING:

Some things are predictable. The sun rises every morning. You know ahead of time that it will rise every day. If you drop a hammer from a height of 5 feet, you need not see it fall to know that it has, in fact, fallen.

Make two lists, one with events which are predictable and a second with things which are not predictable. In each list include at least 7 entries.

AIM FOR:

2 lists with 7 entries

CAUSE & EFFECT

SIDETRIPS

NEEDED:

1 student
Paper & pencil

WHAT'S DOING:

If you stand outside while it's raining, you'll get wet. Rain is the CAUSE, getting wet is the EFFECT. If you sunbathe too long, you'll get sunburned. Too much sun is the CAUSE, sunburn is the EFFECT. Eating too much causes you to gain weight. The spin of the earth causes water to flow in a funnel as it empties out of a tub.

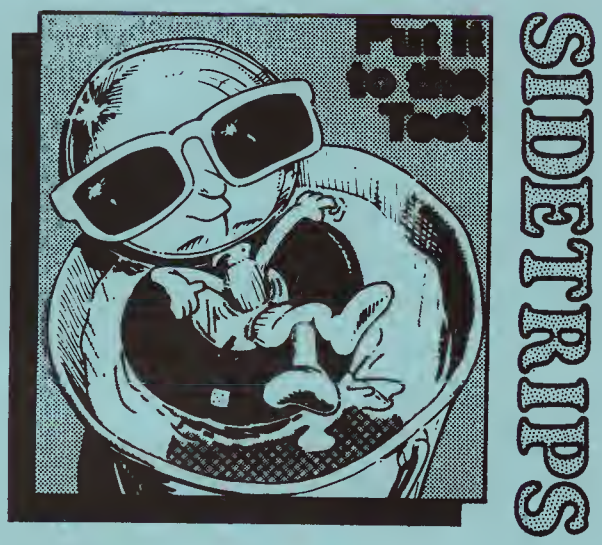
CAUSE	EFFECT
Spin of the earth	Spinning funnel
Over-eating	Gain in weight
.	.
.	.
.	.

Can you list different cause and effect pairs? In 5 minutes, list as many as you can.

AIM FOR:

At least 10 cause-effect pairs

WORD EXPERIMENT



NEEDED:

Twelve students divided as follows:
- 4 individuals working separately
- 2 groups of 2 working together
- 1 group of 4 working together

Timepiece
Paper & pencil

WHAT'S DOING:

Divide into groups as shown above. Each group (or person, if working separately) gets one pencil and a piece of paper. In this experiment, you will use the letters in a given word to form new words. The object is to form as many words as possible in a three-minute period. You may only use accepted English words and you cannot use a letter more times than it appears in the given word.

When groups are arranged, ask your teacher for the word you are to use. The teacher will tell you when three minutes have elapsed.

Total the number of unique words created by the 4 individuals working separately, the 4 working in pairs, and the 4 working in one group. Compare these totals.

What conclusions can you draw from the results?
For this task, did it seem that individuals were more productive working alone or in groups?
What tasks might be better accomplished working separately? in groups? Why?
What do you think might be the best grouping arrangement for doing this task?

AIM FOR:

A completed experiment
Answers to follow-up questions

(optional: Try a new experiment comparing a new grouping arrangement with one of the three you used in this experiment. Use a new word.)

NIM

SIDETRIPS

NEEDED:

2 students
21 objects
(paper clips, toothpicks, crayons, rubber bands, thumbtacks, small chips of paper, etc.)

WHAT'S DOING:

NIM is a game and all you need to play is a set of 21 objects. Each round begins by placing the objects in a line. Play alternates with players picking up either 1, 2, or 3 objects in their turn. The player who is forced to make the last pick-up is the loser.

You may need to play a few rounds before you get the feel of the game. A strategy that will win consistently may take some thought and practice. When you have practiced enough, play a set of three or five rounds. If you want, challenge others in your class to a game.

AIM FOR:

Winning in at least 2 rounds